ERDC Topographic Engineering Center

# BTRA-BC/ J-GES

**4th Quarter 2008**

**Issue 5**

## Quarterly Gazette

## In this issue:



## In every issue:



*From the Program Manager…*

*Since the last edition, both programs again have had tremendous successes.*

*Through the outstanding teamwork of the Government, Industry, and Academia, the Engineer Research and Development Center Topographic Engineering Center (ERDC TEC) hosted two very successful GeoEnabled Battle Command workshops. Thanks to Mike Powers for his direction and vision on these events!*

*ERDC TEC was awarded the Special Achievement in GIS Award at the ESRI International User Conference. BTRA BC and J-GES were two of the four programs cited as contributions in receiving the award.*

*ERDC TEC and ESRI have signed a Cooperative Research and Development Agreement (CRADA). The CRADA will facilitate the advancement of GIS technology in support of the warfighter!*

*The initial BTRA BC engines have been posted on the Commercial Joint Mapping ToolKit website for distribution to Army and Joint programs. This is a MAJOR milestone for our program!!!*

*More information on all of these are included in this edition. As always, our bottom line is tangible products and support to the war fighter!*

*- Dan Visone, PM BTRA BC/J-GES*

## BREAKING NEWS - U.S. Army Engineer Research and Development Center's Topographic Engineering Center Receives Special Achievement in GIS (SAG) Award

San Diego, California—The U.S. Army Engineer Research and Development Center's Topographic Engineering Center (ERDC-TEC) has demonstrated vision and leadership, using ESRI's geographic information system (GIS) technology to better serve the world. To recognize this passionate approach to applying GIS solutions, ESRI presented the organization with the Special Achievement in GIS (SAG) Award on August 6, 2008, at the 28th Annual ESRI International User Conference (ESRI UC) in San Diego, California.


*Joe Watts (MapHT), Dan Visone (BTRA BC, J-GES). Jack Dangermond (ESRI) and Linda Graff (DTSS) with SAG Award*

ERDC-TEC uses GIS technology to support four important programs that involve a number of organizations and better equip the country's military. The Joint Geospatial Enterprise Services (J-GES) program uses GIS to give soldiers, especially those on the ground, rapid analysis and situational awareness tools for accomplishing their missions. Battlespace Terrain and Reasoning Awareness-Battle Command (BTRA-BC) helps commanders, soldiers, and systems consider the impacts of terrain and weather on their responsibilities, processes, and communication; for example, ensuring the transmission of time-sensitive information through mountain ranges or a storm.

In addition, the Digital Topographic Support System (DTSS) provides timely, accurate geospatial information about the battlefield to the warfighter, assisting commanders with making effective and efficient tactical decisions. Also, the Human Terrain System (MAP-HT/JCTD) is a toolkit to successfully collect, store, process, analyze, visualize, and disseminate socio-cultural information, which helps commanders understand the "human terrain' in which they are operating.

"At ESRI, we are always deeply impressed by the innovation of our users," says Jack Dangermond, ESRI president. "We want to recognize the efforts of these individuals with our Special Achievement in GIS Award. This recognition is well deserved for how they've applied geospatial technology to address the needs of their industries and communities. They are defining GIS best practices."

GIS combines computer hardware, software, and data to create a tool for capturing, managing, analyzing, and displaying all forms of geographic information. Virtually any information can be linked to a geographic location, allowing users to see that information as part of a complete picture to be analyzed and applied to a problem or issue. With GIS, people can see firsthand how the world works and changes, view and manage information about locations, analyze spatial relationships, and visualize processes. From underground mine modeling to air traffic control, more than 300,000 organizations worldwide rely on GIS to better analyze their environments and make smarter decisions.

Other organizations being honored at the ESRI UC included Chesapeake Energy, the City of Austin, Forsyth County Schools, Greater New Orleans, Inc., the Marine Advanced Technology Center, the Navajo Department of Transportation, the City Planning Department in Bangkok, Thailand, the Norwegian Institute of Public Health, the United Nations Joint Logistics Center, Qatar Petroleum, and more.

To learn more about the 2008 SAG Award winners and to view their photos and project descriptions and images, please visit www.esri.com/sag. More information about ESRI and its GIS solutions can be found at www.esri.com.

## Breaking News - U.S. Army TEC and ESRI Collaborate on Geospatial Research and Development

**Redlands, California** - TEC and ESRI will collaborate to design and build innovative prototypes to demonstrate the next generation of geospatial technology in U.S. Department of Defense (DoD) Battle Command applications.

The U.S. Army Engineer Research and Development Center's Topographic Engineering Center (TEC) and ESRI signed a cooperative research and development agreement for the project on August 5th.

This core research will influence the use of geospatial technology in combat systems throughout the DoD and will significantly contribute to the design of the next generation of geospatial capability in command and control applications.

TEC researches how geospatial technology improves decision-making support throughout the DoD command and control systems. ESRI is the world's leading technology firm for geographic information system (GIS) software, geospatial modeling and analysis, and service-oriented architecture for spatially-enabled applications. The company also has extensive experience in geospatial research and engineering. This cooperative agreement brokers each organization's complementary strengths.

"ESRI has enjoyed many years of successful collaboration with TEC," says Jack Dangermond, ESRI president. "We look forward to working with TEC to design these pioneering prototypes that will support a new generation of defense geospatial capability."

"TEC's ability to provide the warfighter with a superior knowledge of today's complex and ever-changing operational environment depends, in part, on a productive marriage of our geospatial tools, talent, and military geospatial business logic with complementary commercial geospatial information technology," says Bob Burkhardt, TEC's director. "Our partnership with ESRI allows us access to powerful software, database, systems, and architectural concepts critical to our continued success as an Army Geospatial Knowledge Center."

TEC and ESRI will combine their skills and resources to design and develop prototypes of new Battle Command data management and decision support tools. Specifically, ESRI will help TEC identify and incorporate key technologies for the architecture and design of prototypes. These prototypes will serve as reference implementations or model applications that demonstrate improved geospatial capability in battlespace management.

TEC and ESRI will

Design mobile geospatial applications that take advantage of server technology for data updates and synchronization when connected and also operate as independent, stand-alone units when disconnected.

Prepare image services that exploit BuckEye imagery, a combination of high-resolution color images and LIDAR data that supports intelligence, surveillance, and reconnaissance (ISR) and tactical operations. BuckEye imagery is a proven important geospatial resource used in Iraq and Afghanistan.

Design and create several advanced technology defense prototypes that improve the ability of command and control systems to operate with geospatially-aware battlefield objects, server technology that provides tactical-situation awareness, and geospatial technology to analyze human intelligence.

ESRI and TEC will jointly attend technical workgroups and meet with other defense and intelligence agencies to share the results of the research and engineering of the Battle Command geospatial technology developed under the agreement.

# Breaking News - TEC Hosts Two Successful geoEnabled Battle Command and Battlespace Awareness Workshops

*By Mike Powers and Dan Visone*

The US Army Topographic Engineering Center and the Engineer Research and Development Center hosted two (identical) geoEnabled Battle Command and Battlespace Awareness workshops on June 11-12, 2008, providing an opportunity to gain insight with respect to the evolution of geospatial information within Battle Command applications, systems and architectures.

**Presentation Purpose**: Engage Command and Control (C2), Intelligence, Surveillance and Reconnaissance (ISR) and the geospatial communities on recent advances and geo-technology as it relates to: geo-analytics, force interoperability and C2-to-Simulation interoperability. Of importance is the systemic response to the force's requirements, addressing operation needs for applications, doctrinally and TTP founded representation and content for common understanding between distributed personnel and systems, methods of product abstraction to enable the edge of the force and interoperability between C2 and Simulation. Additionally, the approach to be presented is constructed to the greatest degree possible, to be transitionable to the force. To this end, the demonstrated capabilities were predicated upon existing Enterprise capabilities (e.g. CJMTK), open standards, international exchange standards (e.g. JC3IEDM) and consistent with existing architectural frameworks and Service and DoD Policy.

The program was three hours in duration and covered the following topics:

1. Approach to geoEnabling the Force
2. Improving Deliberate Decision Making, Asset Management and Execution
3. Geo-Analytic Tools and Information
   - Enterprise Capability (CJMTK)
   - Next Generation (FY08-09)
4. Geo-Decision Tools and Knowledge
   - Enterprise Capability (CJMTK)
   - Next Generation (FY08-09)
5. Interoperability
   - BML and the JC3IEDM
   - Inter-C2 and C2-to-Simulation

**Terrain and Weather Track**

After lunch, attendees were encouraged to meet in a lab setting with developers for more in depth discussions regarding the full range of functionality and maturity of the demonstrated capabilities and the way ahead for concepts, research and development.

The following tracks were provided:
1. Interoperability
2. Terrain and Weather.
3. Decision Tools
4. GeoBML.

# Identification of Sites for Unmanned Aircraft

*By Scott Tweddale and Kirk McGraw*

## Background

Selection of a suitable Operational Site (OS) for the launch and recovery of Unmanned Aircraft Systems (UAS) is critical to the success of any UAS mission. Consideration of land cover, terrain, and specifications for one or more UAS platforms is a necessary first step in the Operational Site Selection (OSS) process to identify potentially suitable areas and eliminate unsuitable areas. However, perhaps the most critical step in the OSS process is to consider additional dynamic mission, enemy, terrain and weather, troops and support available, time available, civil considerations (METT-TC) factors such as mission, weather, location of enemy forces and Intelligence, Surveillance, and Reconnaissance (ISR) objectives within the context of the current battle situation in order to select the most optimal sites. ERDC-CERL has developed an automated geoprocessing capability, or engine, that rapidly analyzes spatially explicit data in order to identify potential OS for multiple UAS platforms and rank their overall suitability.

The engine evaluates the BTRA-BC Complex (polygons containing geospatial data from the Theater Geospatial Database (TGD) and the BTRA-BC slope/aspect generator) and produces Tier 1 and Tier 2 Tactical Spatial Objects (TSOs). The OSS engine utilizes the BTRA-BC complex polygons and select layers from the TGD as input and identifies potential Operational Sites that meet a set of "non-negotiable" criteria (can't be in a swamp or on a steep slope, etc.) A suitability ranking is then calculated for each site using a set of "negotiable" criteria that reflect how easy it would be to set up an OS, including construction of a runway or use of existing infrastructure for a runway.

## Process

A summary of the process utilized to evaluate criteria and rank polygons according to their suitability to support an Operation Site (OS) is summarized below.

### Non-negotiable Criteria

#### 1. Size

Potential sites must be of sufficient size to accommodate both a minimum runway footprint and all required supporting equipment as summarized in doctrine. The minimum sizes required for multiple UAS platforms are stored in a database and referenced to determine which UAS platforms could be accommodated for each potential site with increasingly larger sites able to support a greater number of platforms. In the current implementation, a small buffer is added to the minimum size requirement to partially account for glide path requirements. Existing airfield polygons or polygons representing segments of existing airfields are automatically identified as meeting size requirements and are not subjected to size criteria

#### 2. Slope

Slope must be < 1.7%

#### 3. Landover

Polygons may not be open water (lakes, reservoirs, swamps, inundated areas, rivers, or streams). Water features represented by linear features in the TGD are evaluated separately under "Near-ground obstacles" in the negotiable criteria.

### Negotiable Criteria

All polygons satisfying non-negotiable criteria are evaluated against the following "negotiable" criteria to determine an overall suitability ranking.

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| CRITERIA | WEIGHT |
|---|---|
| Existing Infrastructure and Condition | 50 |
| Vegetation/Vertical Obstacles | 15 |
| Transmitter Range/LOS | 10 |
| Near-Ground Obstacles | 5 |
| Soil Composition | 2.5 |

### 1. Existing Infrastructure and Condition

Existing airfields provide the most desirable OS because they require no construction and provide ample room for supporting equipment and are void of any vertical obstructions or glide path restrictions. In the absence of existing airfields, paved roads may be suitable for runways, assuming there are no vertical obstructions. Paved roads are more desirable than unpaved roads because they are likely to provide a smoother surface and because of the increased probability of airborne debris from unpaved roads that can potentially damage UAS platforms. Therefore, potential sites are evaluated based on the type and condition of infrastructure they contain according to the following sub-ranking scheme. The relatively high overall importance of the Existing Infrastructure and Condition criterion relative to all other criteria creates an effective bias towards existing airfields and roads, with an added bias towards airfields. With all other criteria being equal, potential sites containing some sort of existing airfield or road will receive the highest suitability ranking because no significant construction will be required.

| | |
|---|---|
| Existing Airfield | 50 |
| Existing Paved Road | 30 |
| Existing Unpaved Road/Airfield | 20 |
| No existing infrastructure | 0 |

### 2. Vegetation/Vertical Obstacles

Polygons are assigned a value=15 if they do not contain trees or orchards and they are not identified as built-up/urban. Polygons containing existing airfields are automatically assigned a value =15, as it is assumed that no vertical obstacles are present.

### 3. Transmitter Range/Line of Sight

A critical aspect of UAS site selection is ensuring the site provides good transmitter coverage of the area of operations. Potential sites are evaluated based on the percentage of total Air Maneuver Network (AMN) segments that are contained in the transmitter viewshed. The transmitter viewshed represents the total area of the AMN at a given altitude that is visible from the OS and takes into account the transmitter range associated with each platform as well as line-of-sight with respect to topography. A value between 1 and 10 that is equal to total percentage of AMN segments/10 is assigned to each site (e.g. site with viewshed containing 87% of AMN segments = 8.7)

### 4. Near-ground obstacles

In the absence of existing infrastructure that can be utilized as a runway, near ground obstacles must be removed to provide a level surface to be used as a runway. Therefore, potential sites are assigned a value = 5 if they do not contain near-ground obstacles such as rivers, streams, canals, cart tracks, above ground pipelines, bridges, overpasses, viaducts, shrublands, crops, grasslands, or vineyards. Polygons containing an existing airfield or roads with no bridge, overpass, or viaduct are automatically assigned a value = 5 because it is assumed that such infrastructure would be void of any near-ground obstacles and therefore the potential site should not be penalized, even if other near-ground obstacles are found within the site.

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### 5. Soil Composition

Sandy soils are unacceptable because they do not provide sufficient ground density to support operations and they are more likely to produce airborne debris that can potentially damage UAS platforms. Any potential site that does not contain "Inorganic silts and very find sand" is assigned a value = 2.5. All potential sites containing existing infrastructure (airfields and roads) are automatically assigned a value = 2.5 because it is assumed that the existing infrastructure could support launch and recovery, even if the surrounding soil composition is unacceptable.

## Results

### Tier 1 OSS TSO

The primary foundation product from the OSS engine is the Tier 1 OSS TSO which includes an attribute containing the total suitability ranking for each potential site that satisfied the non-negotiable criteria. The suitability ranking is a sum of rankings assigned to each of the non-negotiable criterion. The maximum possible suitability ranking is 82.5 in the current implementation. Additional criteria under consideration for implementation include historical wind (weighting factor = 15) and temperature (weighting factor = 2.5) that may increase the maximum possible suitability ranking to 100. In addition to the suitability ranking, attributes for each individual criterion are retained to allow the user to identify which criteria were or were not satisfied for any given potential site.

### Tier 2 OSS TSO

Given a user specified UAS platform and area of interest, the engine produces a Tier 2 OSS TSO that identifies the top 3 recommended OS according to their suitability ranking. The location, footprint, and transmitter range for each can then be rendered in Commander's Support Environment (CSE) (Figure 1) to support the military decision making process.

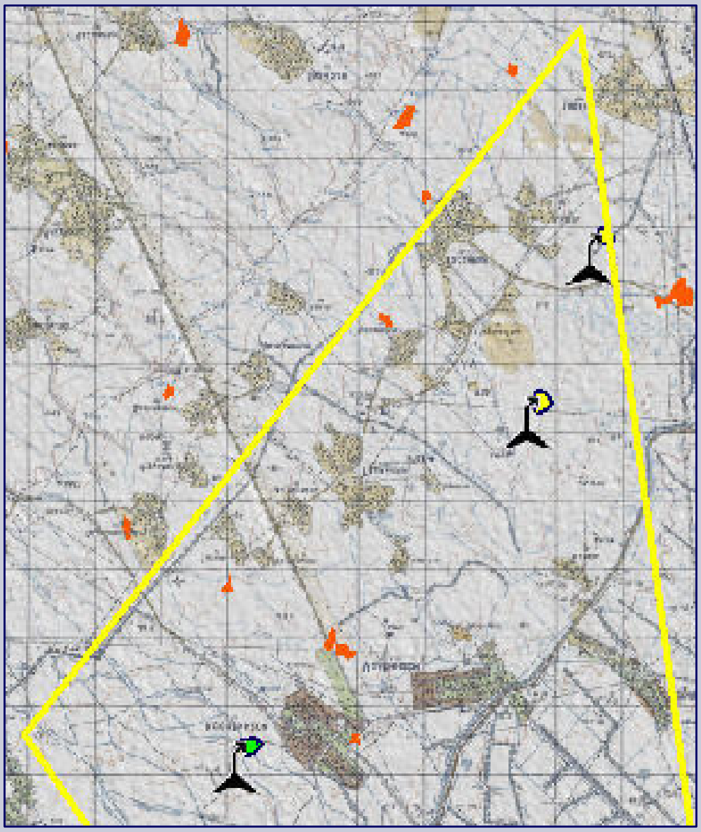

*Figure 1. Tier 2 TSO indicates top three Tier 1 (orange) UAS Operational Sites within Area of Interest (yellow boundary). Tier 2 sites range from yellow (acceptable) to green (best).*

## Future Developments and Enhancements

Future research will be directed at using historical weather such as prevailing wind direction and wind speed at ground level criteria to create the Tier 1 products that consider specific runway orientations. To increase the number of potential sites, adjoining complex polygons that are identical with respect to non-negotiable attributes will be combined into a single larger polygon prior to evaluating different potential orientations. A glide path restriction analysis is also under development to evaluate approach restrictions with respect to topography for specific orientations and platforms.

In the Tier 2 product, a capability will be added to allow the user to specify a desired runway orientation when selecting the top 3 suitable OS for a given area of interest and platform/s. In addition, an algorithm to assess the spatial pattern of potential OS will be implemented to ensure that the top 3 suitable OS sites are well dispersed across the area of interest to provide diverse Courses of Action.

# J-GES Value Experiment #2: Evaluation of Advanced Automated Geospatial Tools in a Mission Context

*By Walter Powell*

**Summary:** Value Experiment #2 is a direct follow-on to Value Experiment #1 which assessed the value added of Advanced Automated Geospatial Tools in a terrain analysis scenario. The specific purpose of Value Experiment #2 is to further assess the value added of Battlefield Terrain Reasoning and Awareness – Battle Command (BTRA-BC) tools in a military planning scenario. In this experiment, sixteen U.S. Army officers (O3-6) with staff planning experience will be tasked to perform identical, complex planning tasks on similar terrain using Commander's Support Environment (CSE), an advanced Command and Control (C2) system, with and without BTRA-BC functionality. A statistical analysis will be performed on the data gathered.

**Experimental Design**: The experiment is structured as a within-subjects design (i.e., participants perform similar tasks using CSE both with and without BTRA-BC). The tasks involve planning a maneuver schema for the companies of a Brigade Combat Team (BCT) battalion. The tasks include terrain analysis, route planning, concealment analysis, selecting hide and battle positions, evaluation of possible hostile force Courses of Action (COA) and Named Area of Interest (NAI) generation. The order of the with BTRA-BC and without BTRA-BC trials and the order of the scenarios will be counter-balanced and randomly assigned in order to control for the effects of these parameters in our analysis.

**Hypotheses:** The experiment is designed to test the following hypotheses:

1. The participants perform tasks faster with BTRA-BC than without BTRA-BC.
2. The products produced by participants are of higher quality when using BTRA-BC than without BTRA-BC.
3. The knowledge and understanding of the effects of terrain on decision-making are at least as good for participants using BTRA-BC as for those not using BTRA-BC. A concern is that participants will accept BTRA-BC output and not further analyze the BTRA-BC output with respect to the terrain.
4. The participants believe BTRA-BC helps them to complete tasks faster, more easily, and with higher quality output, and is better overall.

The value added of BTRA-BC tools will be assessed by the following measures:

1. Time to task completion: This measure was highly significant when evaluating Tier 1 tools, but the opinion of SMEs' is that with more complex problems the participants will use all the time available to refine their products. Therefore this measure may not be as significant in Value Experiment #2.
2. Subjective quality of the output: Subject matter experts (SME) will evaluate the information presented and the clarity of the presentation of the output. Because of (1) above this may be the most important of the measures.
3. Knowledge of the impact of terrain on the military problem – SMEs will evaluate the participants' answers to questions requiring reasoning about the terrain.
4. Participants' perception of the value of AAGT – Participants will complete a questionnaire designed to elicit their perceptions of BTRA-BC's effect on how quickly and easily they can produce planning products, the quality of their products, and an overall evaluation of using BTRA-BC.

**Preliminary results.** The first half of Value Experiment #2 was conducted the week of 14 APR 08 with eight participants from the Army's Battle Command Battle Lab. The results of statistical analyses on the data from these eight participants are presented for each hypothesis. These results should be considered preliminary, for they may change after all sixteen participants complete the experiment.

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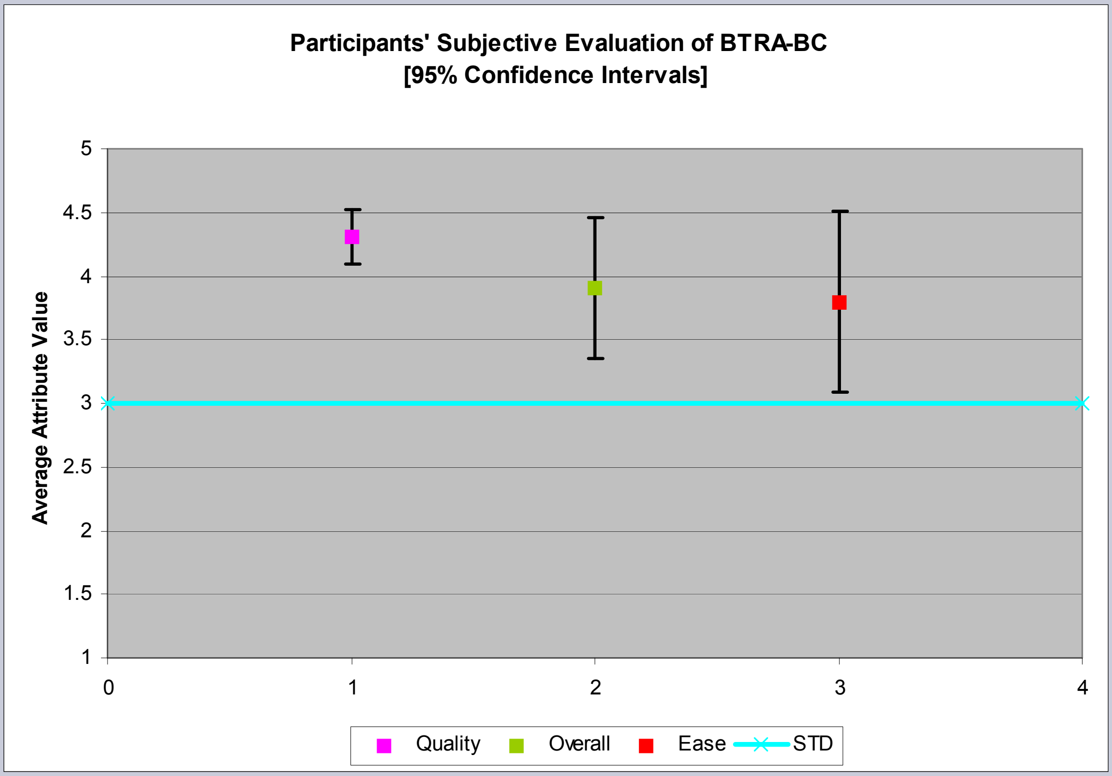
Hypothesis 1: **There is no statistical evidence thus far that the average time to completion is different when participants use BTRA-BC from when they don't.** Although this result does not support hypothesis (1), it is not unexpected. Subject Matter Experts opined that the participants would use all the time allotted and that significant results would instead be in plan quality.

Hypothesis 2: **Statistical analysis on 13 criteria suggests that, on average, participants generated higher quality plans with BTRA-BC ($p = 0.09$).** An additional post-hoc analysis using the active duty status of the participants as a dummy variable reinforces this result in that participants who used BTRA-BC generated higher quality plans with $p=0.04$. These preliminarily results suggest that once all sixteen participants complete the experiment that we may have statistically significant results consistent with hypothesis (2).

Hypothesis 3: **Average terrain understanding also was higher with BTRA-BC, but the effect was not as strong.** Like plan quality, a post-hoc analysis which included active duty status yielded a significance level for the System main effect which was higher with than without BTRA-BC ($p = 0.08$). Otherwise, the statistical test for terrain understanding did not approach significance. In either case, this preliminary analysis is consistent with the hypothesis (3) that terrain understanding will be at least as good with BTRA-BC as without BTRA-BC.

Hypothesis 4: Even with only eight participants, **there was strong statistical evidence that participants believe that they can produce a higher quality plan with BTRA-BC.** There was also evidence that participants believe that it is easier to generate plans with BTRA-BC. Overall, the eight participants thought CSE was superior with BTRA-BC.



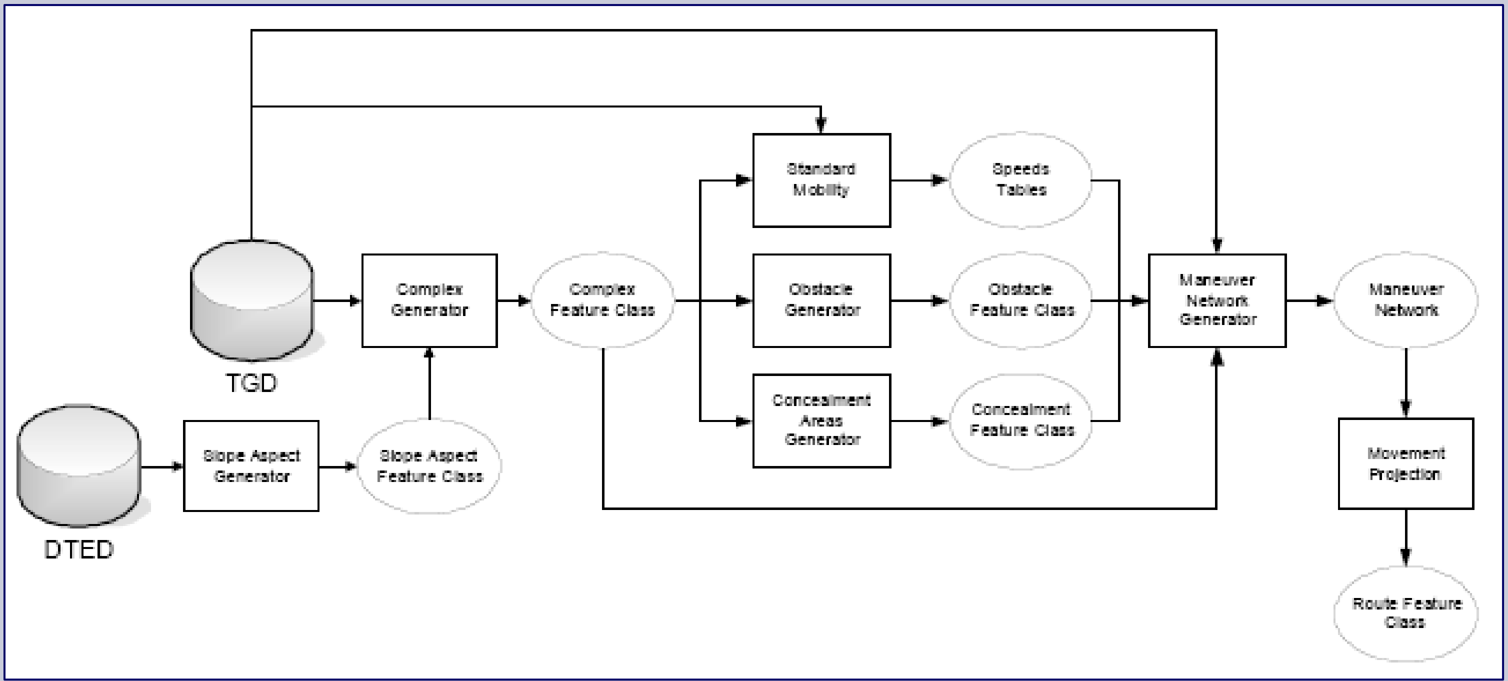

In conclusion, although only half the total number of subjects have participated thus far, the preliminary statistical analyses of plan quality, terrain understanding, and the participants' subjective evaluation are encouraging.

# Battlespace Terrain Reasoning & Awareness - Battle Command (BTRA-BC) Tools Testing

*By Larry Cook*

Work is continuing on gathering performance statistics for the Battlespace Terrain Reasoning & Awareness – Battle Command (BTRA-BC) engines, a set of computational software components that process terrain and weather data to support battle command operations. Under the BTRA-BC program, mature BTRA-BC components will transition to National Geospatial-Intelligence Agency's (NGA) Commercial Joint Mapping Toolkit (CJMTK). Prior to any CJMTK transition, the BTRA-BC program will complete a performance and architecture evaluation of the BTRA-BC engines. Performance testing will consist of measuring execution metrics under various hardware configurations, terrain complexities, and input data sizes. Architecture evaluations will examine various Concept of Operations (CONOPS) involving hardware resources, communications, and data access. The architecture evaluations will help determine the optimum network deployment of the engines, considering factors such as data requirements, network capacity, processing load, and workstation power.

The relationship between the engines is shown in the following diagram:




Researchers at the George Mason University Center of Excellence for Command, Control, Communications, Computing and Intelligence (C4I) are doing the testing. Performance tests were completed on the two initial engines, Slope/Aspect and Complex, during April 2008. In July 2008, researchers at the Center were completing performance testing on the Standard Mobility, Obstacle Generator, and Concealment Area Generator engines. The Standard Mobility generator, developed by the Geotechnical and Structures Laboratory in Vicksburg, MS, uses the Theater Geospatial Database (TGD) and the Rating Cone Index (RCI) value from the Fast All-season Soil Strength (FASST) product as input to calculate speed values for cross country movement and on-road features. The Obstacle and Concealment Area Generators use output from the Complex engine as their data source. The Complex generator provides data with a consistent geometry which increases the performance of the other engines. The Obstacle Generator identifies obstructions, natural or man-made, designed to disrupt movement of an opposing force. The Concealment Area generator identifies areas that provide protection from observation or surveillance. This generator

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identifies concealment areas by determining a concealment score based on vegetation, slope, and aspect.

The engines are being tested under the following environment:

- Shuttle XPC Workstation
- 2.4 GHz Intel Core Duo Processor
- 2 GB Ram
- 5400 RPM IDE Disk Drive
- Windows XP SP2 including all current hot fixes
- Java Run Time 1.5.0_06
- ESRI ArcEngine 9.2 SP5

Test data included three areas in Korea and an area from the National Training Center at Fort Irwin. The sizes of the areas in Korea are expressed in terms of 1:50,000 map sheets.

A summary of the test data follows:

| Name | Dimension | Area |
|---|---|---|
| 2x2 | 50 x 50 km | 2500 km$^2$ |
| 4x4 | 100 x 100 km | 10,000 km$^2$ |
| 8x8 | 200 x 200 km | 40,000 km$^2$ |
| NTC | Approximately 100 x 100 km | 10,000 km$^2$ |

While the final report on the performance statistics (CPU utilization, Disk utilization, Memory utilization, I/O rate, paging, etc) for these three engines is still being developed, the table below shows raw run-times (hours/minutes/seconds) for the specified data coverage area.

| Coverage Area | Standard Mobility | Obstacle | Concealment |
|---|---|---|---|
| Korea 2x2 | 1:41:51 | 8:10 | 30:25 |
| Korea 4x4 | 7:45:43 | 2:17 | 2:59:48 |
| NTC | 1:38:03 | 23:13 | 23:00 |

The George Mason C4I center will begin testing the final two engines, Maneuver Network and Movement Projection, upon completion of the full report for the Standard Mobility, Obstacle and Concealment engines.

# Image Server Experiment #2 Underway

*By Doug Caldwell*

The Joint-Geospatial Enterprise Services (J-GES) Program is currently working with ESRI to test the ability of their ArcGIS Image Server product to perform on-the-fly orthorectification and mosaicking of the U.S. Army's Buckeye high resolution data.

Buckeye is a rapidly fielded, spiral development program of the U.S. Army Engineer Research and Development Center's (ERDC) Topographic Engineering Center (TEC). It has evolved to its current state. Buckeye provides soldiers with high quality battlefield information through high-resolution imagery; geospatial intelligence; elevation data; intelligence, surveillance and reconnaissance (ISR); and detailed maps of the urban area of interest. The data produced through Buckeye is available to all of the US Armed Services and intelligence communities via SIPRNET.

*Buckeye Color Imagery*

In Image Server Experiment #1, ESRI demonstrated a basic capability to orthorectify a small sample Buckeye data on-the-fly. This experiment was supported by TEC's Operations Division and complemented their on-going work with ArcGIS Image Server and Buckeye data. Currently, they are serving Buckeye orthophotos using Image Server. The results from the initial experiment were disappointing, as the use of raw camera parameters produced low accuracy imagery for the on-the-fly rectification process.

Image Server Experiment #2 hopes to overcome the limitations of Image Server Experiment #1 by using enhanced versions of the Buckeye image which contain Rational Polynomial Coefficient (RPC) camera models. Testing of the enhanced imagery should be completed in the fall of 2008. If the results are successful, this approach could eliminate the requirement to orthorectify the Buckeye imagery prior to serving it to users.

## *Recent Events...*

**BTRA BC:**

11,12 Jun 08 - GeoEnabled Battle Command Workshops
Jun 08 - Coalition Warrior Interoperability Demonstration 08
12 Jun 08 - BTRA presentation at the GALE User Conference
31 Jul 08 - BTRA presentation to Future Combat Systems
Aug 08 - GeoBML demonstration at the ESRI Defense Intelligence Executive Track
Aug 08 - BTRA and GeoBML presentations at the ESRI International User Conference

**J-GES:**

Jun 08 — DTSS JSBA Assessment
11 Jun 08 - J-GES briefing to West Point visitors
2 Jul 08 - J-GES demonstration to SASC and OCLL Staff
21 Jul 08 - J-GES visit to Ft. Irwin for baseline assessment of enterprise capabilities in the field.
Aug 08 - J-GES synchronization presentation at the ESRI International User Conference.

# Q3 FY08 GeoBML Update

*By Harland Yu*

For most of the GeoBML team, this past quarter was an opportunity to analyze, reflect upon and report on the progress we made over the previous six months of development. The results of all this introspection can be found in several conference papers, presentations, and demonstrations taking place in the upcoming months:

- A GeoBML demonstration at the ESRI International Users' Conference
- Three presentations at the Users' Conference - the Casualty Collection Points TSO, the TSO engineering process, and an overview on the BTRA Prototype Job-Server architecture.

A paper submitted to the Fall Simulation Interoperability Workshop authored by Systematic and Howard University titled, "Interacting with multiple implementations of the JC3IEDM: Issues and a High Level Solution"

The capability demonstrated during the ERDC-wide demonstration in May provided the cornerstone for a briefing on Geo-enabled Battle Command hosted at TEC. In addition to a presentation in the morning, there were several break-out sessions hosted by the entire GeoBML team in the J-GES lab. These break-out sessions allowed the attendees to talk directly to team members on details about the technology and concepts. It was a great chance to exchange ideas and information with the larger Army community.

ESRI and Northrop Grumman are teaming up to start transitioning GeoBML functionality to the larger CJMTK community. Initial areas that will be investigated include determining the optimal strategy for storing TSOs, designing a software component that will let users search for TSOs given a particular area of interest and/or TSO type, and understanding the workflow in registering the TSOs for discovery in a Global Information Grid (GIG) environment.

Finally, we are in the process of gathering requirements and topics to discuss at a planning meeting that will be held in late August at West Point, NY. This will chart the course for the GeoBML development team and provide direction on the technical architecture over the next fiscal year.

## *Government Leads/ POCs…*


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# Replication/Synchronization Experiment #3 Ongoing

*By Doug Caldwell*

With the completion of Replication/Synchronization Experiment #2 in June 2008, the Joint-Geospatial Enterprise Service (J-GES) team has moved on to Replication/Synchronization Experiment #3. Replication/Synchronization Experiment #3 is focusing on the transfer of Theater Geospatial Database (TGD) information between the Theater-level Geospatial Planning Cells (GPCs) and the National Geospatial-Intelligence Agency (NGA). This moves the experiments from the laboratory to the operational environment. Replication/Synchronization Experiment #3 will be done in a phased approach to reduce the risk and minimize the impacts on the participants.

TGD vector data will initially be transferred from the GPCs to NGA via the File Transfer Protocol (FTP) using Personal Geodatabases or File Geodatabases. The Army and NGA have jointly prepared a Standard Operating Procedure (SOP) for this exchange that describes the file formats, associated documentation, and transfer mechanism. The US Pacific Command (PACOM) began transferring data in August 2008. Upon successful application of PACOMs TGD data, the SOP will be utilized by all the GPCs.

The Topographic Engineering Center (TEC), Maneuver Support Center (MANSCEN), and NGA will begin testing a one-way synchronization capability early in the fall of 2008. This will simulate the one-way transfer of data from the GPCs to NGA. The purpose of the tests will be to validate the architecture for the system and develop the Tactics, Techniques, and Procedures (TTPs) for its operation. Upon successful completion of the tests and demonstration to the GPCs, the one-way synchronization will replace the FTP transfer of data.

The final test and demonstration of geodatabase replication/synchronization will be the implementation of a two-way transfer of data between the GPCs and NGA. This would support not only the transfer of data from the GPCs to NGA, but the transfer of data from NGA to the GPCs. This will take place in the spring or summer of 2009.

While the geodatabase replication/synchronization capabilities address the requirements for the transfer of vector data, they do not support the synchronization of raster data, which is usually stored in files. Raster data would include products like Compressed Arc Digitized Raster Graphics (CADRG), Controlled Image Base (CIB) imagery, and Digital Terrain Elevation Data (DTED). Replication/Synchronization Experiment #3 will also investigate the synchronization of files using the Defense Information Systems Agency's (DISA) Enterprise File Delivery (EFD) software. This work is planned to start in the fall of 2008.

Replication/Synchronization Experiment #3 brings a comprehensive approach to the problem, covering both database and file-based synchronization. With the movement of the experiments from the laboratory to the operational environment, the research will have a positive and direct impact on the warfighter.

## *Upcoming Events...*

BTRA BC:

August 2008 - GeoBML Subject Matter Expert Off-Site

J-GES:

September 2008 - CJMTK Geospatial Appliance testing w/DTSS and Common Map Background

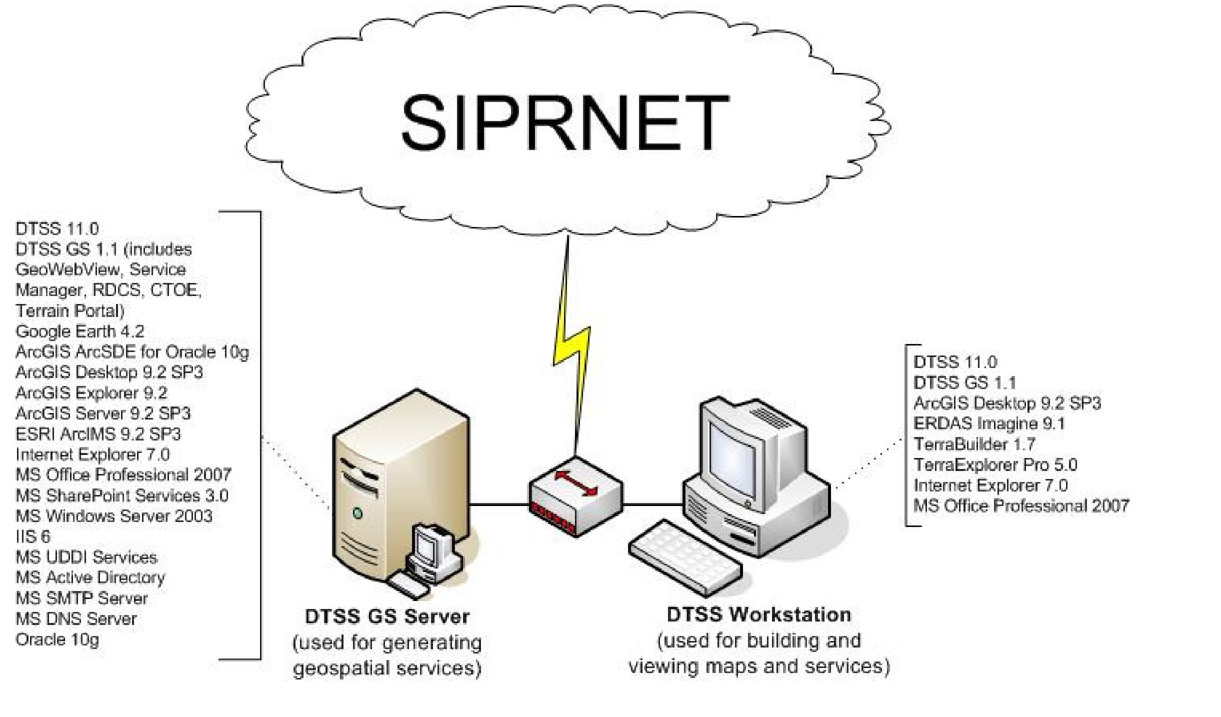
October 2008 - Replication/ Synchronization Experiment #3
This will look at simulating the transfer of TGD data over SIPRnet with TEC and NGA participating.

1QY09 - Demonstrate DISA's Enterprise File Delivery software for transferring M&S data, and use Shunra appliance for emulating transfer over constrained networks

# Digital Topographic Support System Geospatial Services (DTSS GS) Joint Systems Baseline Assessment (JSBA) Testing

*By Daniel Bentz*

The Joint-Geospatial Enterprise Services (J-GES) Lab served as the Digital Topographic Support System Geospatial Services (DTSS GS) node in the 2008 Joint Systems Baseline Assessment (JSBA 08) held during the months of June and July. JSBA is sponsored by the Joint Systems Integration Command (JSIC) of U.S. Joint Forces Command (USJFCOM) and is designed to evaluate the interoperability of operational net-centric Command and Control (C2) and Intelligence, Surveillance, and Reconnaissance (ISR) Systems and selected systems projected to be fielded in the near future. The event consisted of five Objectives: (1) Joint Targeting, (2) Distributed Common Ground System (DCGS) to C2, (3) Collection Management, (4) Cross Domain Services, and (5) Standards. A DTSS GS 1.1 server and a DTSS 11 Workstation installed in the J-GES lab (see the diagram below) took part in the Technical Assessment (TA) and Operational Assessment (OA) phases of the Standards Objective. The purpose of these assessments was to assess a system's ability to produce and consume Open Geospatial Consortium (OGC) standards, including Web Map Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS) in a service oriented architecture (SOA) and to take part in the GEOINT open Web services mission thread used in the Empire Challenge 08 exercise. DTSS GS was successful in consuming web services available from other systems participating from remote sites including: the Global Command & Control System - Joint (GCCS-J), Integrated C4I System Framework (ICSF), and the Integrated Meteorological System (IMETS). These systems were also able to successfully consume the WMS services provided by DTSS GS in their viewers. The results of this experiment demonstrated the values of Open GEOINT services to allow access to both national and tactical level producer services, to provide dynamic geospatial info and updates, and to expose information (services) to wide set of Consumers (clients). JSIC will be publishing a JSBA 08 Summary Report this fall.




**JSBA 08 DTSS GS Node Configuration**

US Army TEC J-GES Lab

# Battlespace Terrain Reasoning and Awareness-Battle Command (BTRA-BC) Commercial Joint Mapping ToolKit (CJMTK) Extensions (BCE) Update

*By Scott Clark and Mike Dillon*

## ♦ BTRA-BC 1.0 Release

The first release of the BTRA-BC engines has been posted to the CJMTK website (www.cjmtk.com). The engines are available in the CJMTK downloads section. The Reference Implementation Sample Application (RISA) was posted in August. The engines that have been released are:

- Slope Aspect Generator
- Complex Generator
- Concealment Area Generator
- Obstacle Generator
- Standard Mobility
- Maneuver Network Generator
- Common Data Service


The BCE team is now devoting its energy to finalizing the Movement Projection engine test harnesses in preparation for official testing and release in late August / early September. In addition, Standard Mobility is being updated with the capabilities needed to fully support the upcoming Cross Country Mobility engine. These features include being able to input weather, season, and ground condition (dry/wet/average).

## ♦ Coalition Warfighter Interoperability Demonstration (CWID) 2008

The BCE program recently concluded two weeks of CWID 2008 trials at Dahlgren, EUCOM, and SPAWAR. The Java version of the BTRA-BC Movement Projection functionality was successfully used with the CJMTK Java Framework to provide a platform for running the CWID exercises and integrating with the CJMTK Geospatial Appliance (CGA). The CWID trials were able to demonstrate Weighted, One-Way, and Named Area of Interest (NAI) routing over seven different maneuver networks, each with unique terrain features. The CWID trials also provided all Tier One feature data from the BCE data preparation engines, including Choke Points, Mobility Corridors, and Obstacles. Background maps were available through the CGA, using a combination of ESRI and OCG map services to provide raster and vector data. The trials were evaluated and executed by Warfighters from the Army and Marine Corps, who provided valuable feedback on the current BTRA-BC technologies.

# BTRA-BC TSO Engine Development Update

*By Adam Kuchinski*

| *Component* | *Status* | *Target Delivery to CJMTK* | *Notes* |
|---|---|---|---|
| Cross Country Mobility | Prototype Completed Development Ongoing | Fall 2008 | Provides both Off-Road and On-Road mobility scores |
| Standard Mobility Enhancements | Development Ongoing | Fall 2008 | Exposing several new weather and vehicle input parameters |
| Dismounted Maneuver Network | Development Ongoing | Fall 2008 | Will be compatible with Movement Projection route solvers |
| Choke Areas | Development Complete<br>Testing Underway | Winter 2008/2009 | Determines maneuver choke points for different echelons |
| Movement Projection Enhancements | Development Ongoing | Winter 2008/2009 | Improving performance and adding 6 new custom route solvers |
| Fast All-Season Soil Strength | Development Ongoing | Winter 2008/2009 | Predicts the state of the ground based on current weather conditions |
| Engagement Areas | Prototype Completed | Spring 2009 | Identifies areas suitable for use in conjunction with a firing position |
| Assembly Areas | Development Ongoing | Spring 2009 | Identifies locations suitable for assembly of heavy maneuver forces |
| Ambush Areas | Prototype Completed | Spring/Summer 2009 | Identifies locations possessing high potential for an ambush |

## Replication/Synchronization Experiment #2

*By Doug Caldwell*

The Joint-Geospatial Enterprise Services (J-GES) Replication/Synchronization Experiment #2 was completed in June 2008. This experiment built on the lessons learned in Replication/Synchronization Experiment #1 and focused on the key recommendations. Three new capabilities were tested: improved automation and customization, data review, and mobile data collection.

Participants included the Topographic Engineering Center's J-GES Program and Operations Division, the U.S. Army Maneuver Support Center (MANSCEN), the National Geospatial-Intelligence Agency (NGA), and ESRI. Replication and synchronization were performed at echelons from the National level to Below Brigade using a subset of the Theater Geospatial Database (TGD) covering Fort Polk, LA, and the Washington, DC area.

There were a number of lessons learned during Replication/Synchronization Experiment #2. As confirmed in Experiment #1, the technical aspects of the replication/synchronization process work as advertised. The issues in successfully implementing a solution are more organizational and architectural, rather than technical.

A significant amount of effort was put into Experiment #2 in order to make the process easier for users. The names of databases, versions, replicas, and type of synchronization were loaded as part of the set-up, so users could perform one-click replication/synchronization by simply knowing their echelon and the type of operation they wanted to perform. This greatly simplified the process for the user.

Experiment #2 tested both connected and disconnected operations. In connected operations, the versions of the database were synchronized over the network. In disconnected operations, one user saved database changes to a file, which the other user imported. The connected synchronization worked smoothly. The disconnected synchronization required a number of steps that had to be performed in sequence and was found to be more fragile.

The Custom Data Reviewer tool developed for Experiment #2 allowed the user to visualize differences in versions. This proved very valuable, as it caught changes which are categorized as conflicts, as well as any other differences between the two versions. This tool was transferred to the Combat Terrain Information System (CTIS) program for use in their development.

Monitoring the overall status of the replication/synchronization process proved to be a challenge. One recommendation coming from the experiment proposed the development of a dashboard that would allow a user to see the participants in the synchronization process and the status of their systems and updates.

Mobile clients were added in Replication/Synchronization Experiment #2. Using ESRI Mobile Application Development Framework (ADF) and ArcGIS Server software, Below Brigade

### *Distinguished Visitors...*

**<u>June 11th, 2008</u>**
United States Military Academy West Point:
Dr. John A. Brockhaus
LTC Michael D. Hendricks
MAJ Ian Irmischer
CPT William Charles Wright
CDT Peter Martin Friedewald
CDT Jeffrey Taylor Dow
CDT Geoffrey David Ross

<u>July 2nd, 2008</u>
SASC and OCLL Staff
Dr. Arun Seraphin
Mr. Charles Hutton
Mr. Antonio Baines

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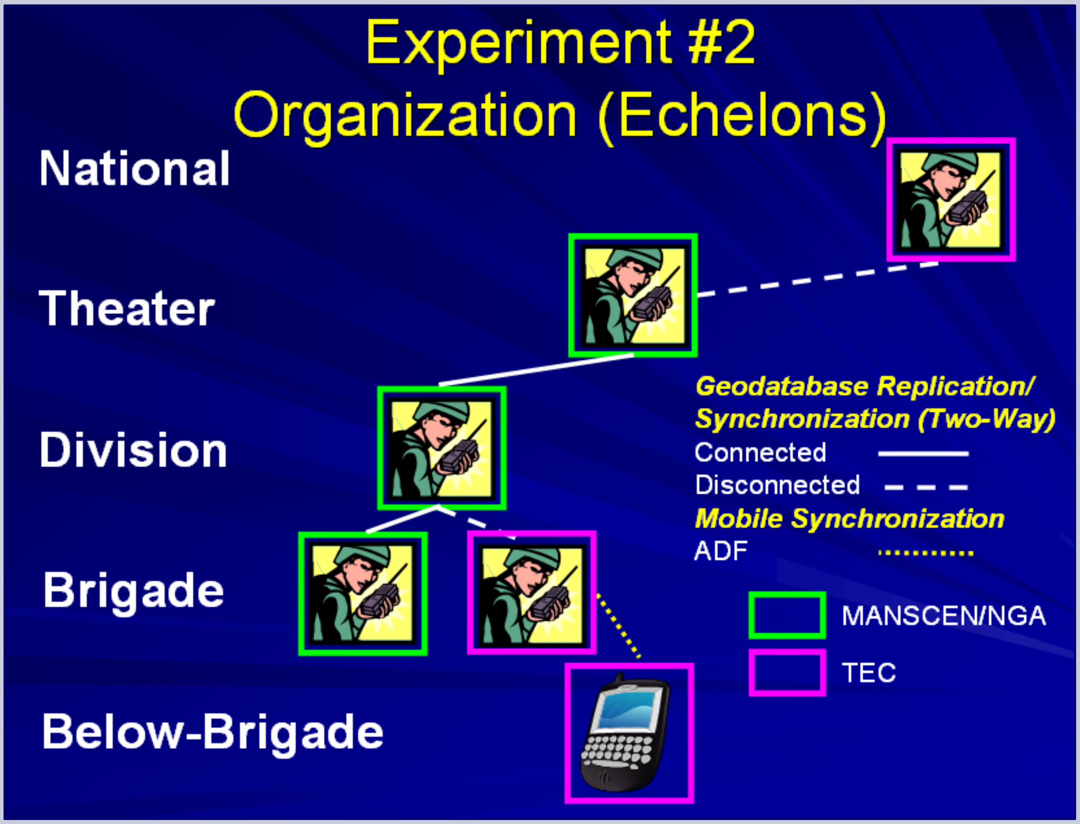
clients were able to create, delete, and modify point, line, and area features using a Motorola MC35 cell phone and wirelessly synchronize the data with the Brigade database. Geospatial data was added using a sketch tool, as well as the GPS capabilities of the cell phone. The testing demonstrated the basic functionality, but a number of fixes and enhancements will be required before this technology will be robust enough for field application.

An After Action Report was prepared upon the completion of the experiment and is available on request.




*The participants and organization of Replication/Synchronization Experiment #2.*

## Websites:

BTRA-BC: http://www.tec.army.mil/btra/index.html

JGES: http://www.tec.army.mil/JGES/index.html

# ESRI User Conference Presentations

### Terrain Reasoning for Course of Action (COA) Development by Doris M. Turnage

TRACK: Battle Command
GIS enables commanders to examine multiple, often competing, courses of action to make their decisions. This session will cover the benefits of terrain spatial objects in the Geospatial Battle Management Language for delivering actionable geospatial information to commanders.

Session : Date/Time: Thu, Aug 7, 10:15AM - 11:30AM

Within course of action development, a military commander and staff manually select locations on the battlefield, identified through graphical control measures, which support the overall operational plan. The goal of this research effort is to automate the process of identifying alternative tactical logistics graphical control measures to aide the commander's decision through the use of Tactical Spatial Objects (TSOs) built on terrain reasoning and analysis within the Geospatial Battle Management Language (GeoBML). Each terrain based alternative graphic control measure provided to the commander will be generated through analysis of mission, enemy, and terrain stemming from doctrinal information and lessons learned from military commanders. These controls will drive the generation of automated algorithms to produce tactical logistic control measure alternatives to the maneuver commander for selection. Using this methodology, our research will focus on the development of a Casualty Collection Point (CCP) for the commander to employ during the operation.

### BTRA CJMTK Extensions by Scott Clark

Track: CJMTK Developer Experiences
Session: Date/Time: Wed, Aug 6, 3:15pm - 4:30pm

The objective of the BTRA CJMTK Extensions (BCE) is to provide the Battlespace Terrain Reasoning Awareness (BTRA) analysis capabilities to the Commercial Joint Mapping Toolkit (CJMTK) mission application development community. BTRA performs research and development to create advanced geospatial analysis and processing capabilities, supporting mission planning. The BCE effort provides a mechanism to transition the capabilities from BTRA to programs that can leverage those capabilities and field them to the Warfighter. The BTRA capabilities include analysis engines, data manipulation routines, and other software products in support of terrain reasoning. The BCE program staff is transitioning the BTRA capabilities by conducting cross-platform testing, building Reference Implementation Sample Applications (RISAs) and packaging them for distribution to the CJMTK developer community. This presentation will provide an overview of current activities along with a preview of future BTRA capabilities.

### Geospatial BML: Bringing Actionable Geospatial Information to the Warfighter by Harland Yu and Mike Case

Track: Battle Command
Session : Date/Time: Thu, Aug 7, 10:15AM - 11:30AM

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The Geospatial Battle Management Language (GeoBML) program provides a conceptual framework for tailoring actionable geospatial information (called tactical spatial objects) in order to support the Warfighter's mission and enhance the decision making process. GeoBML applies to several domains: military mission planning and operations, information exchange across the battlefield, and modeling and simulation. The implementation of GeoBML's concepts builds upon the U.S. Army/Topographic Engineering Center's Battlespace Terrain Reasoning and Awareness program and leverages several key technologies such as the Multilateral Interoperability Programme's (MIP) Command and Control Information Exchange Data Model (C2IEDM) and the Commercial Joint Mapping Toolkit (CJMTK). This presentation will focus on the progress made in building a test/reference implementation to experiment with various aspects of GeoBML's employment in U.S. Army operations.

Track: Topographic Support
Military commanders require digital spatial data and models to power their C4ISR and decision support systems. The papers in this session cover database replication, GeoBML, and NGA’s Enterprise Product on Demand Services (ePODS) program.

Session: Date/Time: Tue, Aug 5, 3:15pm - 4:30pm

### Systematic Process for Selecting Tactical Spatial Objects (TSOs) for Development by Doris Turnage

On the battlefield, maneuver commanders and their staffs most often rely on two dimensional maps and satellite images to analyze terrain and manually select those locations that will best support their overall operational plan. To aide in this process, considerable amount of time and effort has been asserted into representing Tactical Spatial Objects (TSOs) within the Battlefield Terrain Reasoning and Analysis (BTRA) program and Geospatial Battle Management Language (GeoBML). However, at this time there is not systematic process documented to select which TSOs to develop in order to best support a maneuver commander’s plan at the tactical or operation level. The goal of this research effort is to establish and document a clear, concise, and executable process to aide in selecting those TSOs for development that will have the greatest impact on implementation of the overall objectives of the BTRA / GeoBML research effort in support of the warfigther.

### U.S. Army ArcGIS 9.2 Replication/Synchronization Experiments by Dan Visone and Doug Caldwell

The Engineer Research and Development Center (ERDC) and the U.S. Army Maneuver Support Center (MANSCEN) are investigating the ArcGIS Replication/Synchronization capabilities to support the Army's Concept of Operations (CONOPS) for the update and distribution of the Theater Geospatial Database (TGD) in the field. This investigation is taking place in a set of experiments evaluating capabilities through a series increasingly complex and realistic tests. Replication/Synchronization Experiment #2, completed in spring 2008, involved echelons from the National to the Brigade level. This experiment built upon the results of Replication/ Synchronization Experiment ##1, which tested the CONOPS using out-of-the-box capabilities. In Replication/ Synchronization Experiment ##2, workflows were automated, customized, and reworked to reflect the soldiers’ perspective of the operation and organization. Additional quality control steps were added and collection capabilities were expanded to include mobile data collection. Results of this experiment were used to develop ‘lessons learned’ as well as identify technology and organizational issues.

## Job Well Done!

Major Mike Rainey is presented with an Engineer Research and Development Center coin by Mr. Randy Jones of the Geotechnical and Structures Laboratory (GSL) for his dedicated efforts as their Subject Matter Expert on the Battlespace Terrain Reasoning and Awareness Battle Command program.

## Team Members…